

CLAIMS

What is claimed is:

1. A packet-switched multiple-access network system comprising a shared communication channel, a first station connected to the shared communication channel, and a second station connected to the shared communication channel, wherein the first station and the second station each comprise:
a network interface, the network interface transmitting packets to the channel and receiving packets from the channel; and
a distributed fair priority queuing MAC (Media Access Control) protocol executed by the first station and by the second station, the distributed fair priority queuing MAC protocol resolving packet collisions between the first station and the second station on a per packet per access priority basis.
2. The system as in Claim 1 wherein the network interface further comprises:
a multiple access controller, the multiple access controller executing the distributed fair priority queuing MAC protocol.
3. The system as in Claim 2 wherein the network interface further comprises:
a carrier and signal detect that communicates with the multiple access controller, the carrier and signal detect detecting the presence or absence of transmissions on the channel.

4. The system as in Claim 3 wherein the network interface further comprises:
a demodulator, the demodulator converting received transmissions into packet data.

5

5. The system as in Claim 4 wherein the network interface further comprises:
a modulator, the modulator converting packet data into signals for transmission, wherein the transmission of the station is controlled by the multiple access controller using carrier sense.

10

6. The system as in Claim 5 wherein the network interface further comprises:
a collision detect that communicates with the multiple access controller, the collision detect detecting the presence of a simultaneous transmission (a collision).

15

7. The system as in Claim 6 wherein time intervals between packet transmissions over the channel are divided into a plurality of contention slots, and the contention slots are used for packet transmission contention opportunities that are ordered according to access priority.

20

8. The system as in Claim 7 wherein the signal slots are used for signaling opportunities for the first station and the second station to share information used for collision resolution by the distributed fair priority queuing MAC protocol.

5
3
9. The system as in Claim 8 wherein the signal slots are used for signaling opportunities for the first station and the second station to share information used for collision resolution implemented using a tree or stack-based collision resolution technique.

10 10. The systems as in Claim 8 wherein each station contending for access in a given collision resolution cycle pseudo-randomly selects among the possible signal slots and signals that vote by transmitting a signal in the selected signal slot.

11. The system as in Claim 8 wherein the network interface further comprises:

15 a first counter per priority that indicates the stack level above current active stations with which the first station is waiting to resolve its collision, and control logic executed by the first station and the second station for incrementing and decrementing the first counter based on one or more of the following: (a) a carrier sense signal; (b) a collision detect signal; or (c) voting signals.

20

12. The system as in Claim 11 wherein the network interface further comprises a second counter that indicates the maximum stack level per priority of the first station and the second station, wherein the second counter is used to initialize the first counter when the first station has prepared a new packet for transmission.

5

13. The system as in Claim 8 wherein the pattern of votes used in a collision resolution cycle conveys side-band signaling information from the first station to the second station, and a deterministic label indicator slot is used to indicate that the pattern of votes is the result of the first station intending to convey side-band signaling information.

10
14. The system as in Claim 8 wherein the pattern of votes used in a collision resolution cycle conveys side-band signaling information from the first station to the second station, where the pattern of votes is used to specify a subordinate level of priority within the priority level associated with the collision resolution cycle.

15

15. The system as in Claim 8 wherein the pattern of votes used in a collision resolution cycle is chosen such that the probability of any second station further colliding with the first station is reduced.

20

16. The system as in Claim 8 wherein the collision resolution cycle comprises two, three, or four signal slots.

17. The system as in Claim 8 wherein the plurality of contention slots, which are ordered according to access priority, are further used for segregating transmissions at different baud rates or different modulation rates.

5 18. The system as in Claim 6 wherein collisions are signaled from the transmitting stations to all other stations by a duration of transmission interval that is distinguishable from the range of transmission intervals used by non-colliding transmissions.

10 19. The system as in Claim 18 wherein the first station simulates a collision by forcing its transmission to have a duration that falls within the predetermined interval defined for collisions.

15 20. The system as in Claim 6 wherein the communication channel is selected from the following group:

- a) baseband, utilizing frequencies down to DC;
- b) frequency division multiplexed, wherein each channel uses a distinct passband of frequencies on the physical medium;
- c) code division multiplexed, wherein each channel is associated with a set of pseudo-random code sequences; or

d) time division multiplexed, wherein each channel occupies a specific time interval in a repeating time frame.

21. The system as in Claim 6 wherein the physical medium of the channel is
5 selected from the following group:

- a) twisted pair;
- b) coaxial cable;
- c) power line;
- d) optical fiber;
- e) infrared; or
- f) wireless radio frequency.

10 22. The system as in Claim 6 wherein the signal modulation used to encode packet data is selected from the following group:

- 15 a) pulse amplitude modulation;
- b) quadrature amplitude modulation and carrierless amplitude phase modulation;
- c) multi-tone modulation; or
- d) frequency or phase modulation.

23. The system as in Claim 6 wherein a HOLDOFF signal is used to suspend the distributed fair priority queuing MAC protocol for a predetermined time interval such that the predetermined time interval can be used for access by a third station that is not executing the distributed fair priority queuing MAC protocol.

24. The system as in Claim 23 wherein the HOLDOFF signal and a transmission timed to end at a frame boundary is used to implement a synchronous frame interval within which the distributed fair priority queuing MAC protocol functions.

25. Computer data signals in a carrier wave signal transmitted over a packet-switched multiple-access network comprising:

a collision signal, the collision signal indicating a collision of a packet sent by a first station connected to the network with a packet sent by a second station connected to the network; and

at least two contention slots, the contention slots, which each have a different priority to provide multiple levels of priority of access, being used for contention transmission opportunities controlled by a distributed fair priority queuing MAC (Media Access Control) protocol executed by the first station and by the second station to resolve the packet collision on a per packet per access priority basis.

26. The carrier wave signal as in Claim 25 further comprising:

multiple signal slots, the signal slots being used for signaling opportunities by
the first station and by the second station to share information used for collision
resolution by the distributed fair priority queuing MAC protocol executed by the first
station and by the second station.

5

27. The carrier wave signal as in Claim 25 further comprising:

side-band signaling at the MAC layer, the side-band signaling providing
information for the PHY (physical) layer; and

10 a deterministic label indicator slot for indicating that the pattern of votes is the
result of a station intending to convey side-band signaling information for the PHY
layer.

28. The carrier wave signal as in Claim 25 further comprising:

15 a HOLDOFF signal, the HOLDOFF signal being used to suspend the
distributed fair priority queuing MAC protocol for a predetermined time interval such
that the predetermined time interval can be used for access by a third station that is not
executing the distributed fair priority queuing MAC protocol.

20 29. A method for a packet-switched multiple-access network, the method
comprising:

transmitting packets to a shared communication channel and receiving packets from the channel; and

executing a distributed fair priority queuing MAC (Media Access Control) protocol, the distributed fair priority queuing MAC protocol resolving packet collisions on the channel on a per packet per access priority basis such that stations connected to the channel will have a fair and prioritized opportunity to transmit pending packets.

5 30. The method as in Claim 29 further comprising:

10 detecting the presence or absence of transmissions on the channel.

31. The method as in Claim 30 further comprising:

demodulating received transmissions into packet data.

15 32. The method as in Claim 31 further comprising:

modulating packet data into signals for transmission.

33. The method as in Claim 32 further comprising:

detecting a collision.

34. The method as in Claim 33 further comprising:
providing a plurality of contention slots, the contention slots being used for packet transmission contention opportunities that are ordered according to access priority.

5

35. The method as in Claim 34 further comprising:
providing a plurality of signal slots.

36. The method as in Claim 35 wherein the signal slots are used for signaling opportunities for the first station to share information with other stations, which are connected to the channel, used for collision resolution by the distributed fair priority queuing MAC protocol.

15 37. The method as in Claim 35 wherein the signal slots are used for signaling opportunities for a first station to share information with other stations, which are connected to the channel, and the signal slots are used for collision resolution protocol implemented using a tree or stack-based collision resolution technique.

20 38. The method as in Claim 35 wherein each station contending for access in a given contention resolution cycle pseudo-randomly selects among the possible signal slots and signals that vote by transmitting a signal during the selected signal slot.

39. The method as in Claim 35 further comprising:
providing a first counter per priority that indicates the stack level above the current active stations with which the station is waiting to resolve its collision, and
incrementing and decrementing the first counter based on one or more of the following: (a) a carrier sense signal; (b) a collision detect signal; or (c) voting signals.
- 5
40. The method as in Claim 39 further comprising:
providing a second counter that indicates the maximum stack level per priority for any station connected to the channel, wherein the second counter is used to initialize the first counter when the first station has prepared a new packet for transmission.
- 10
41. The method as in Claim 35 wherein a pattern of votes used in a collision resolution cycle conveys side-band signaling information from the first station to other stations connected to the channel.
- 15
42. The method in Claim 35 wherein a pattern of votes used in a collision resolution cycle is used to convey a subordinate level of priority within the priority level associated with the collision resolution cycle.
- 20

43. The method in Claim 35 wherein a pattern of votes used in a collision resolution cycle is chosen such that the probability of any second station further colliding with the first station is reduced.

5 44. The method as in Claim 35 wherein a collision resolution cycle comprises two, three or four signal slots.

10 45. The method as in Claim 35 wherein collisions are signaled from transmitting stations to other stations connected to the channel by a predetermined duration of transmission interval that is distinguishable from the duration of transmission intervals used by non-colliding transmissions.

15 46. The method as in Claim 45 wherein the first station simulates a collision by forcing its transmission to have a duration that falls within the predetermined duration defined for collisions.

47. The method as in Claim 34 further comprising:

20 transmitting a HOLDOFF signal, the HOLDOFF signal being used to suspend the distributed fair priority queuing MAC protocol for a predetermined time interval such that the predetermined time interval can be used for access by a station that is not executing the distributed fair priority queuing MAC protocol.

48. The method as in Claim 34 wherein the plurality of contention slots are further used for segregating transmissions at different baud rates or different modulation formats.

5

49. The method as in Claim 34 wherein data packets are transmitted over the channel and the signal slots are transmitted over a second channel.

10

50. The method as in Claim 41 further comprising:

providing a deterministic label indicator slot for indicating that the pattern of votes is the result of a station intending to convey side-band signaling information.

Ridgway
Ridgway